COWFISH

Habitat Capability Model

Northern Region
Fish & Wildlife Staff
June 1986

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Habitat Capability Model

U. S. Forest Service
Northern Region
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by

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This model was prepared as part of the Northern
Regions Fish and Wildife Staffs
Fish Habitat Relationships Program
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PREFACE

This model is part of the Northern Region's Wildlife and Fish Habitat Relationships Program (WFHR), and is the first in a series of aquatic models quatifying fisheries habitat capability. It is patterned after the U.S. Fish and Wildlife Service's Habitat Suitability Index (HSI) Model Series put out by the Western Energy and Land Use Team.

The difference between a Habitat Capability Model and a Habitat Suitability Model is that the capability model translates the HSI values into actual animal numbers or values. In this model the HSI value (0.0 - 1.0) is a secondary output.

This model and its relationships were developed to reflect the characteristics and productivity levels of the drainages found on the forests in the eastern half of Montana. If this model is to be used in other areas that have significant differences in the parameters, adjustments in the values displayed in the field guide and in the spreadsheet should be made.

This document is to replace the working draft of COWFISH that was made available for model validation and testing in 1985. This model is a hypothesis of fish habitat relationships and not intended to be a definite statement of proven cause and effect relationships.

Acknowledgements

I sincerely appreciated the assistance given by a number of Forest Service employees which include William Platts (Intermountain Research Station), Paul Brouha (Washington Office), Don Bartschi, Ron Escano and Bill Hardman (Region One office) and Mit Parsons (Wildlife and Fish Ecology Unit). The Regional Fishery Managers were instrumental in distributing the draft for review.

I also want to thank Ray White and Clayton Marlow from Montana State University as well as the staff from Interfluve, Inc. for reviewing the drafts. I appreciate the efforts of numerous Forest Service range personnel who provided input and worked with the system in the field. Bill Donnelly (Region One Office) was very helpful in incorporating the program into the Data General System.

I. Introduction

This model is designed to assist resource specialists in analyzing the condition of the riparian environment in relation to the past and current livestock grazing management and to estimate the compatibility of the grazing with associated aquatic resources. It is not intended to replace presently used stream surveys or fish population analysis. Rather it uses existing information to derive an initial indication of how livestock grazing may be affecting trout populations.

The guide provides a site description for the fisheries biologist who may not be familiar with the site, but who may evaluate the data later to make management recommendations. It also provides a rating criteria for the observer to collect basic information for running the model. The rating criteria are designed so that no field equipment or fishery expertise are necessary for collecting the information. The model predicts the effects the past and present grazing system may have on the fisheries environment. This information can then be used for discussing allotment management with the permittee.

This document follows the general U.S. Fish and Wildlife Service´s format for HSI documents (USF&W, 1981), and is divided into three sections:

1. Habitat Relationships

2. Model Description

3. User´s Guide

The Habitat Relationships Section summarizes the limiting factors for trout populations in a grassland/shrub ecosystem. Information that can be used to derive quantitative relationships between trout fisheries and grazing are emphasized.

The Model Description Section describes the model and information required for its application. This section includes graphic, word, and mathematical model descriptions. The model´s geographic and seasonal applicability, major assumptions, and limitations are discussed.

The User´s Guide Section is a step-by-step description of how to collect the input information, fill out the field forms and computation sheets, and how to run the Data General software program. The user has the option to hand crank the model or have the computer spreadsheet do the computations.

II. Habitat Relationships

The major limiting factor for fish production in many streams is lack of good quality pools and other cover that is essential for overwintering juvenille and adult fish. On low gradient meadow streams, the primary fish cover is provided by overhanging vegetation and undercut banks. Excessive removal of the vegetation and trampling of the bank by livestock can reduce the ability of those streams to support fish. The landform gradient can influence livestock use in the streambottoms. Steep landform gradients result in abrupt changes in vegetation which, along with the physical nature of the terrain, can encourage livestock to remain in the riparian zone.

The vegetative type along the stream dictates the quantity of grazing the riparian zone can sustain before impacts to the fishery habitat are expected to occur. Streams which primarily support grasses and forbs along the banks are most vulnerable to livestock damage because of vegetative removal and mechanical damage to the banks. As the percentage of willows and other woody vegetation increases within the streambank vegetative composition, protection to the banks and bank vegetation increases. The vegetative type least susceptible to livestock damage is willow/conifer where heavy, woody vegetation provides a considerable amount of protection to the forage plants. Also, in the willow/conifer type bank cover is not as critical to the well-being of the aquatic environment because a larger percentage of instream cover is provided by large debris and rocks.

This model is designed to be used primarily along low gradient, meandering streams where conditions are conducive for high fish production and the associated riparian zones are highly desirable for livestock grazing. These streams generally have undercut banks and low-growing bank vegetation which are essential for fish survival. Preferred bank conditions are often associated with heavy root masses and dense vigorous vegetative growth. An undercut bank is defined as having bank angle of 90 degrees or less. Stream cover of this type is more important to the well-being of a fishery in a low gradient stream meandering through a meadow than it is for a higher gradient stream that has other forms of cover. The higher the dependency fish production has on bank cover, the more it can be influenced by livestock grazing.

Deep narrow channels are more conducive to trout production than are streams with wider, shallower profiles (USDA 1975). This is particularly important for those streams subject to severe climatic conditions. Excessive livestock use within the stream channel can break down the banks which eventually leads to wider and shallower profiles. The sloughing and collapsing of streambanks has probably had the greatest effect the decline on native stream fish populations (Platts 1981).

Excessive fine sediment within the streambed (1/8 inch diameter, or less) can choke out developing fish eggs and fry as well as decrease aquatic invertebrate development (USDA 1981). Embeddedness (filling in of the spaces between the gravel, rubble and boulders with fine sediment) reduces the habitat's ability to overwinter fry and fingerlings. Fine material deposits first in the pools, but as the sedimentation rate increases, accumulation will also occur in the riffle areas. This evaluation is to provide an estimate of fine material throughout the entire streambottom regardless of pool/riffle composition.

Stream gradient can also be an indicator of stream productivity. Steeper streams (in excess of 5 percent) can have less of a carrying capacity for fish production compared to streams with lesser gradients. This is because of the turbulent nature of the flow which generally results in less resting, rearing and spawning areas available to the various life stages of the fish. Under extreme conditions, this can cause physical barriers to fish passage. The stream gradient can be determined by estimating the vertical change in elevation for 100 feet of stream. This vertical drop would be the stream gradient for that section expressed in percent.

III. Model Description

A. Applicability

1. Geographic Area

The model was originally developed for the mountainous regions of central Montana. However, the principles used can be employed throughout the western U.S. since impacts occurring along streams from livestock grazing are similar from one geographic area to another. The carrying capacity of the streams do vary from one area to another so the standing crop values shown in Figure 7 may have to be adjusted accordingly.

2. Season of Use

This procedure can be used to determine stream habitat productivity anytime during the season prior to snow cover. However, the most accurate estimates of grazing effects on fish production would be achieved from an analysis immediately following livestock use.

3. Riparian and Stream Types

Our analysis has shown that the streams most suseptable to livestock damage are those low gradient streams, with erodable banks, flowing through grass/forb riparian zones with stream width of 18 feet or less. We found that fish populations in streams with widths greater than 18 feet are less influenced by livestock grazing than those populations in narrower streams because they are less dependent on bank cover. Streams in a forested riparian zone have a larger percentage of the instream and overhead cover provided by woody vegetation. The model is less accurate for use along those streams with rocky streambanks that do not lend to the natural development of undercut banks.

4. Sample Area

It is recommended that the sample area be at least 100 feet in length to obtain a more accurate assessment of current habitat conditions. Shorter stream sections can be analyzed particularly for the evaluation of livestock crossings and watering sites, however, the results would only reflect population numbers for the immediate area. One 100 foot sample could be used for evaluating a larger section if it were felt by the evaluator that stream conditions were fairly uniform. Under these conditions, a 100 foot sample representing a 300 meter stretch of stream would only constitute a 10% sample size. Obviously, the greater the area sampled, the more representative the sample would be for the allotment. Although it is intended for the results of the analysis to be as realistic as possible, the major objective is to draw attention to what livestock management may be doing to the fishery in general and to instill a sensitivity among livestock managers. At this point, it is left up to the evaluators to how many samples should be taken depending upon the variability of the habitat characteristics, varying intensity of impact occurring to the stream and the length of stream in question.

5. Verification Level

The accuracy of this evaluation procedure depends upon the sample size previously discussed, accuracy of the evaluator in obtaining the field information and on the model itself. The accuracy of the model depends upon the relationships between the parameters and their effect on carrying capacities. These relationships are based on the experiences of numerous experts in the field and data available. It is intended to continue to refine these relationships through studies and by updating the model as necessary.

6. Assumptions

The primary assumption this model makes is the productivity levels for streams within the habitat parameters listed for the models intended geographic use are consistent. It also assumes that there will be little variability in accuracy between users of this procedure.

B. Description

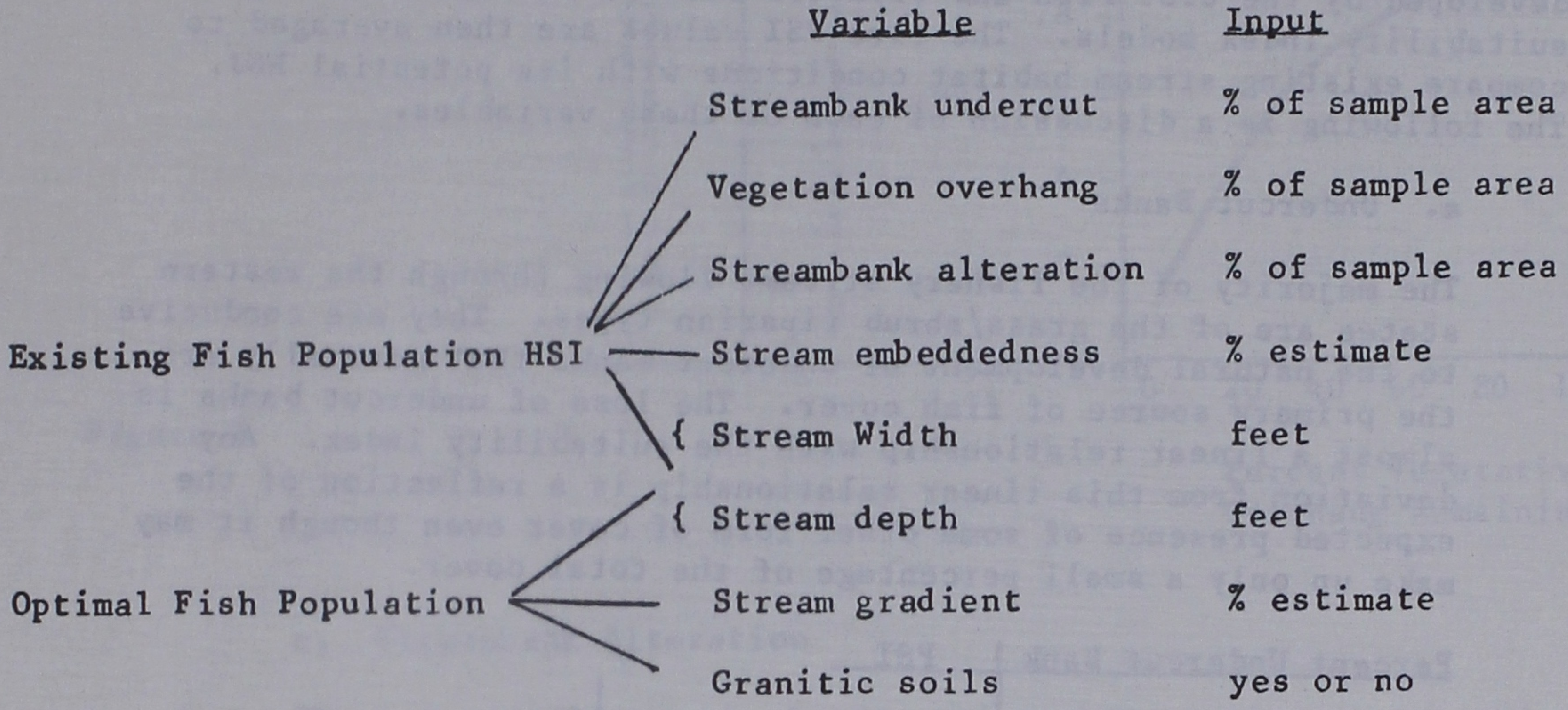
1. Geographic Overview

The model considers six variables in determining a stream's suitability to support trout. These six variables are:

1. The extent of the streambank which is undercut.
2. The extent of the stream edge with vegetational overhang.
3. The extent of the streambank showing bare soil or trampling.
4. Stream embeddedness.
5. Stream width.
6. Stream depth.

Two additional variables, stream gradient and soil type of the drainage, are used to calculate fish production, recreation value, and economic value outputs. Figure 1 shows these eight variables and how they relate to each other in the model.

Figure 1 - Cow-Fish Graphic Model


Existing Fish Population HSI
Optimal Fish Population

Variable	Input
Streambank undercut	% of sample area
Vegetation overhang	% of sample area
Streambank alteration	% of sample area
Stream embeddedness	% estimate
{ Stream Width	feet
{ Stream depth	feet
Stream gradient	% estimate
Granitic soils	yes or no

2. Existing Stream Suitability

The field value obtained for each variable is converted to a parameter suitability index (PSI) based upon principles similar to that developed by the U.S. Fish and Wildlife Service in their habitat suitability index models. The five PSI values are then averaged to compare existing stream habitat conditions with its potential HSI. The following is a discussion of each of these variables.

a. Undercut Banks

The majority of the fishery streams flowing through the western states are of the grass/shrub riparian types. They are conducive to the natural development of undercut banks that generally are the primary source of fish cover. The loss of undercut banks is almost a linear relationship with the suitability index. Any deviation from this linear relationship is a reflection of the expected presence of some other form of cover even though it may make up only a small percentage of the total cover.

Percent Undercut Bank	PSI
85	1.0
75	.9
60	.8
50	.7
45	.6
40	.5
35	.4
30	.3
25	.2
10	.1
0	0

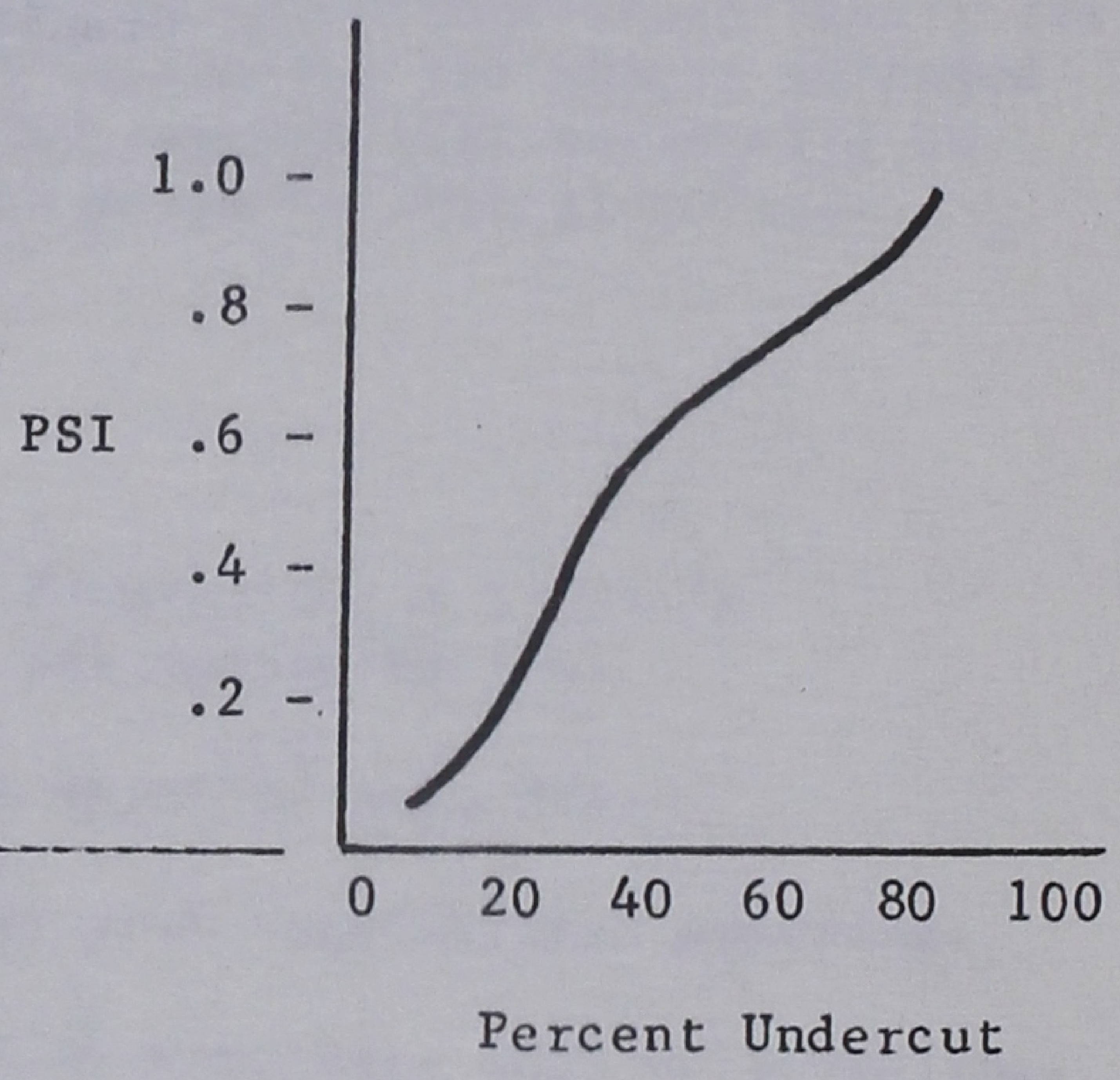


Figure 1

b. Vegetative Overhang

The percent of the bank supporting vegetative overhang at the end of the grazing season is a direct indication of the utilization level occurring within the riparian zone. As more vegetative cover is removed, the rate at which the suitability index drops increases (Hickman and Raleigh 1982). It is assumed that this is showing that as more vegetation is removed in those streams dependent on bank vegetation for primary cover, the vulnerability of the fishery to predatation and environmental hardships accelerates. Platts (1984) showed that the removal of most of the stream cover after the growing season in part increases the erosion rate during the following runoff period.

Percentage Vegetation Overhang	PSI_2
100	1.0
75	.9
55	.8
45	.7
40	.6
35	.5
25	.4
20	.3
10	.2
0	.1
0	0

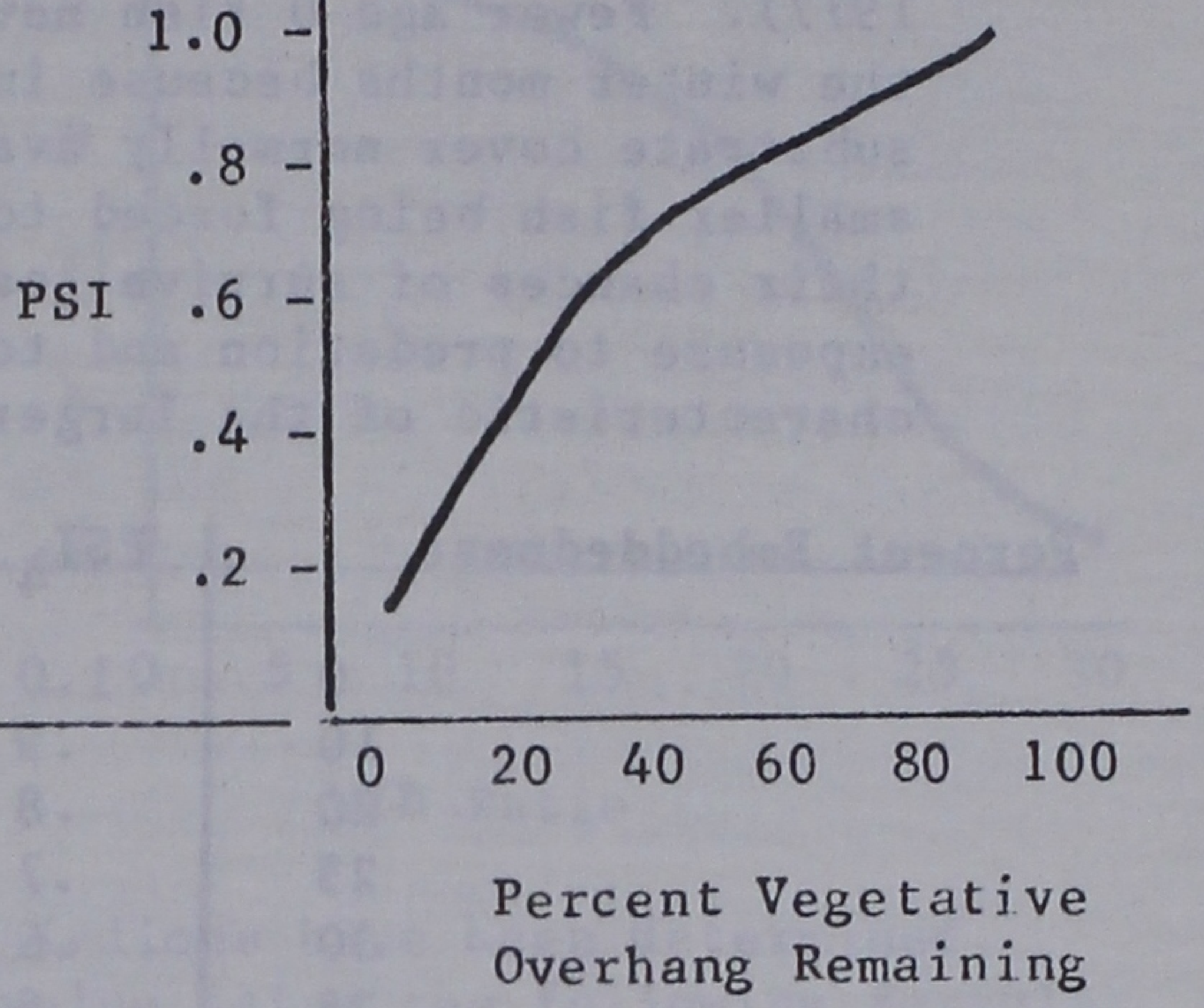


Figure 2

c. Streambank Alteration

The percent of streambank alteration where soils are exposed or being trampled is an estimate of bank stability. As bank instability increases the amount of sediment entering the stream system through bank sloughing and overland flow begins to be a problem. As sedimentation increases, water quality, stream bottom composition, and pool quality deteriorate (Bjornn, 1974).

Percentage Streambank Altered	PSI_3
0	1.0
15	.9
30	.8
35	.7
40	.6
45	.5
50	.4
65	.3
80	.2
90	.2
100	.2

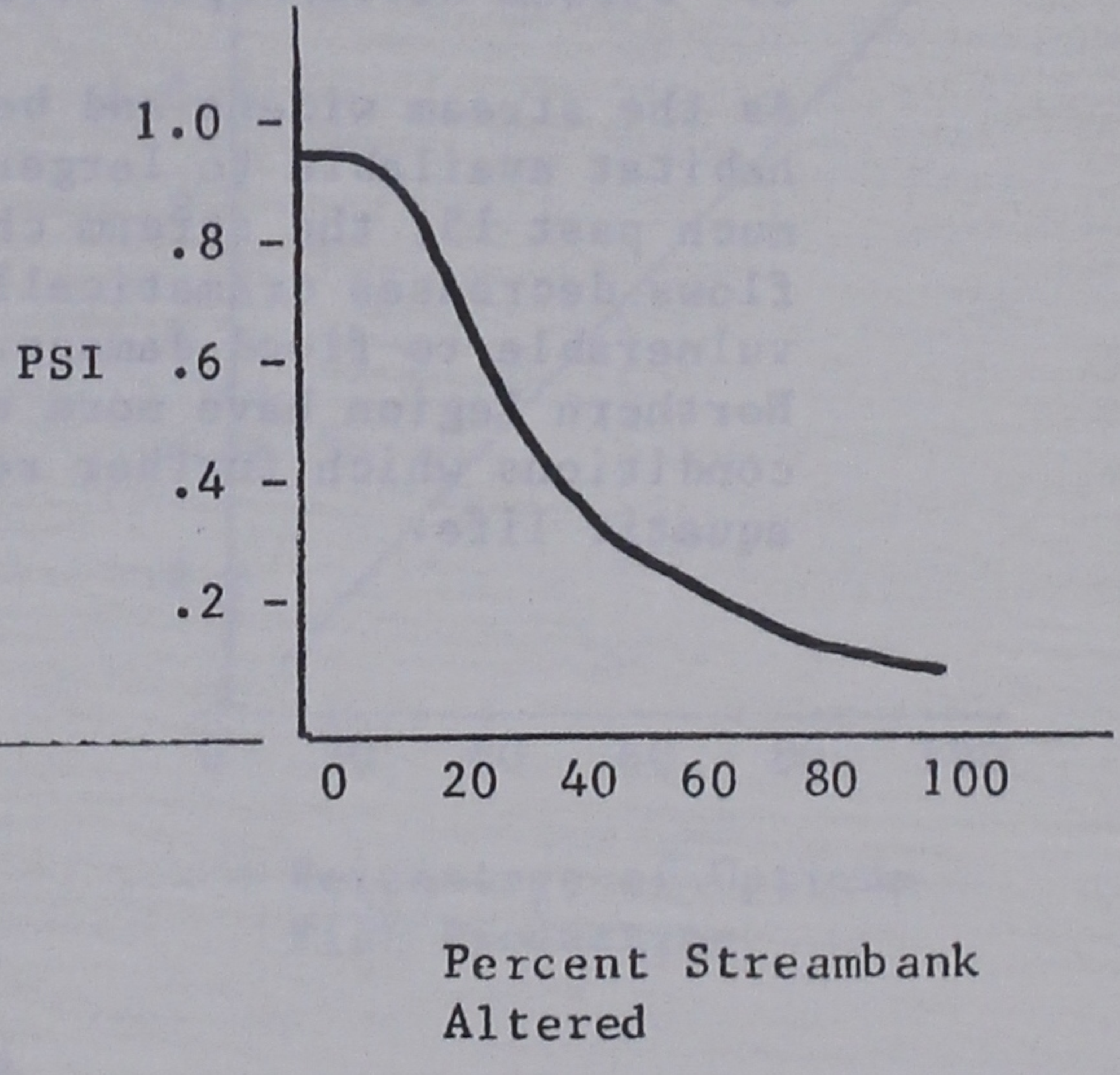
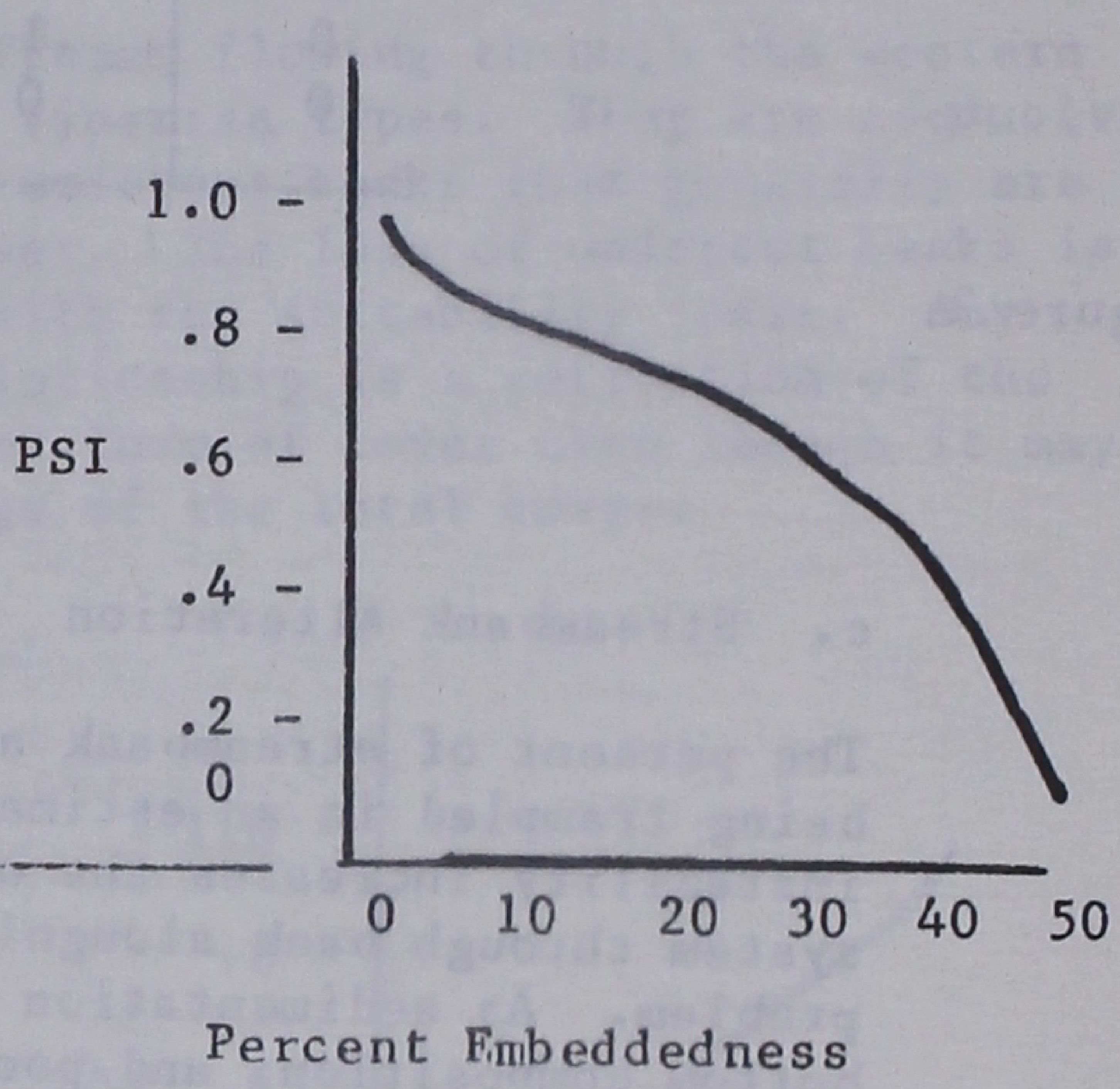


Figure 3

d. Stream Embeddedness

As stream embeddedness increases, there is a tendency for the smaller fish to move from the riffles to the pools (Bjornn, et al 1977). Fewer age 0 fish have been found in the riffles during the winter months because increased sediment reduced the substrate cover normally available to them (Bjornn 1974). With smaller fish being forced to move to the larger pools for cover, their chances of survival can be reduced due to increased exposure to predation and to the aggressive hierarchical behavior characteristic of the larger fish.

Percent Embeddedness	PSI$_4$
0	1.0
10	.9
20	.8
25	.7
30	.6
35	.5
40	.4
43	.3
46	.2
50	.1
55	0



igure 4
(Hickman and Raleigh, 1982)

e. Stream Width/Depth Ratio

As the stream widens and becomes more shallow, the volume of habitat available to larger fish decreases. Once the ratio goes much past 15, the stream channel´s ability to contain most peak flows decreases dramatically (USDA 1975) and becomes more vulnerable to flood damage. Wide, shallow streams in the Northern Region have more surface area exposed to icing conditions which further reduces their capacities to overwinter aquatic life.

W/D Ratio	PSI_5
<5	1.0
6-12	.9
13-18	.8
19	.7
20	.6
21	.5
23	.4
25	.3
26	.2
>26	.1

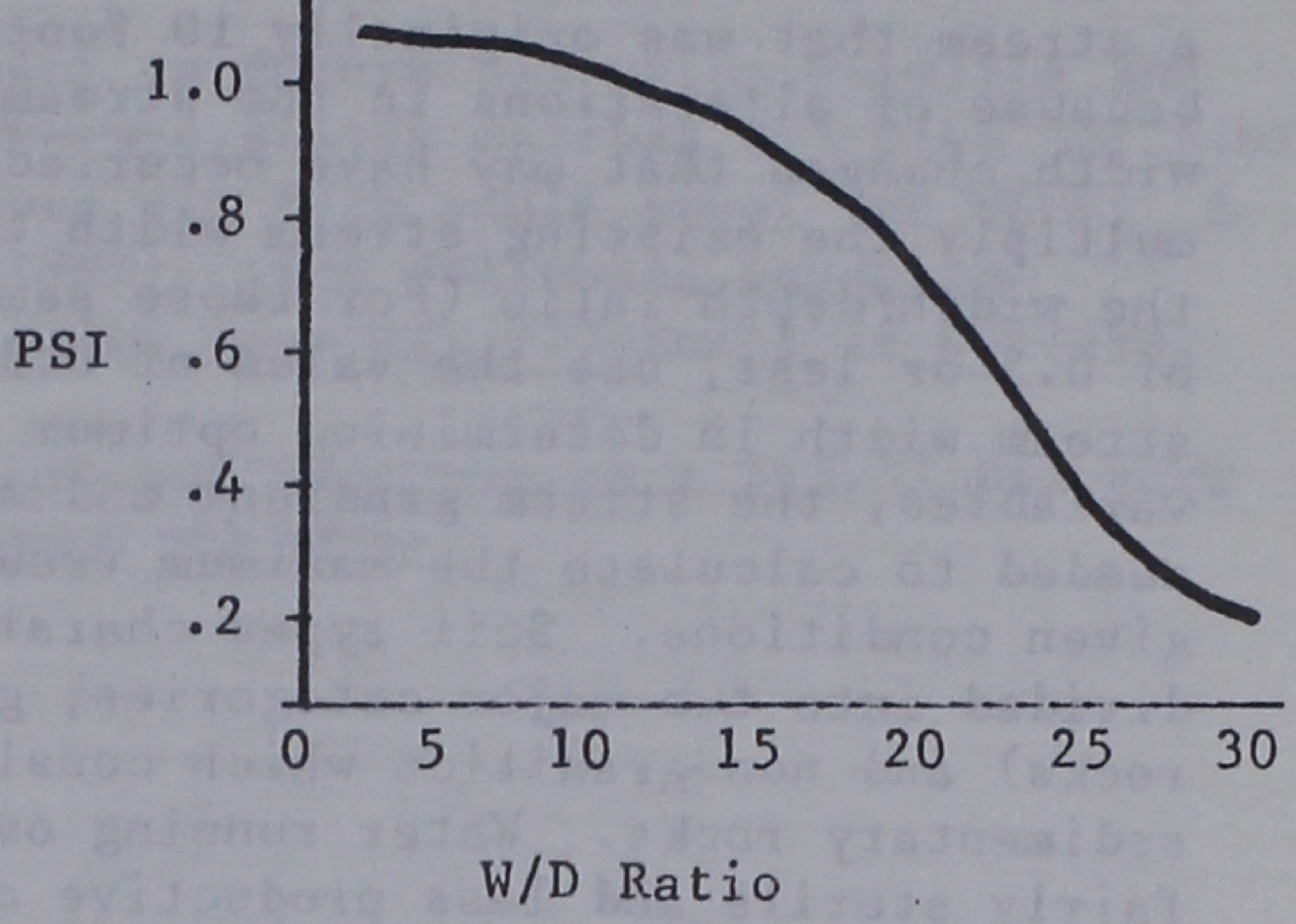


Figure 5

Once the parameter suitability indices have been determined, average them to obtain a mean value using the following formula:

$$\frac{PSI_1 + PSI_2 + PSI_3 + PSI_4 + PSI_5}{5}$$

f. Habitat Suitability Index

The habitat suitability index (HSI), expressed as a percentage of habitat optimum, is determined from the following relationship with the mean PSI.

Mean PSI	Percentage of Optimum (HSI)	
1.0	100%	
.9	90%	Excellent
.8	80%	
.7	70%	Good
.6	60%	
.5	50%	Fair
.4	40%	
.3	30%	Poor
.2	20%	
.1	10%	
0	0	

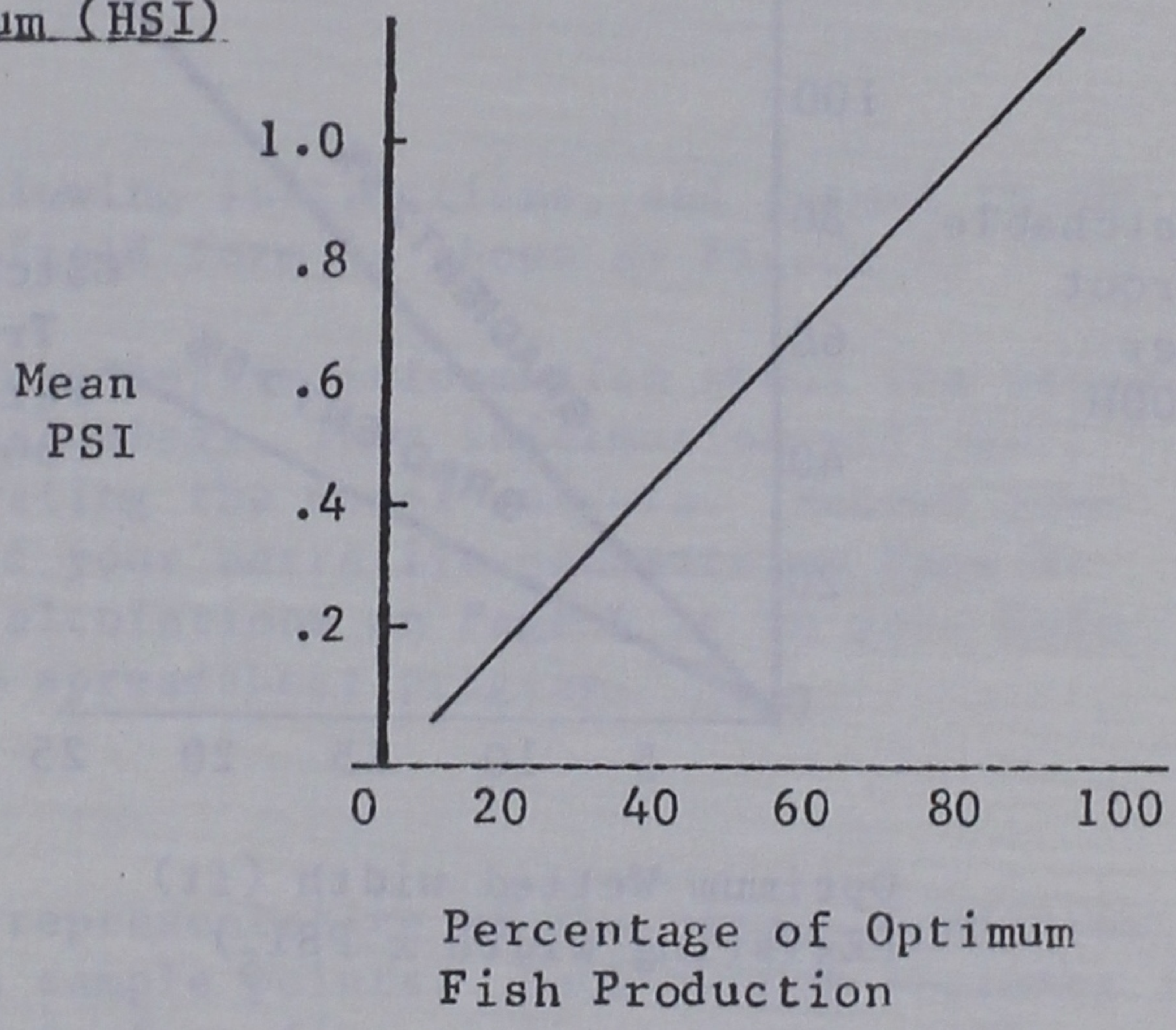
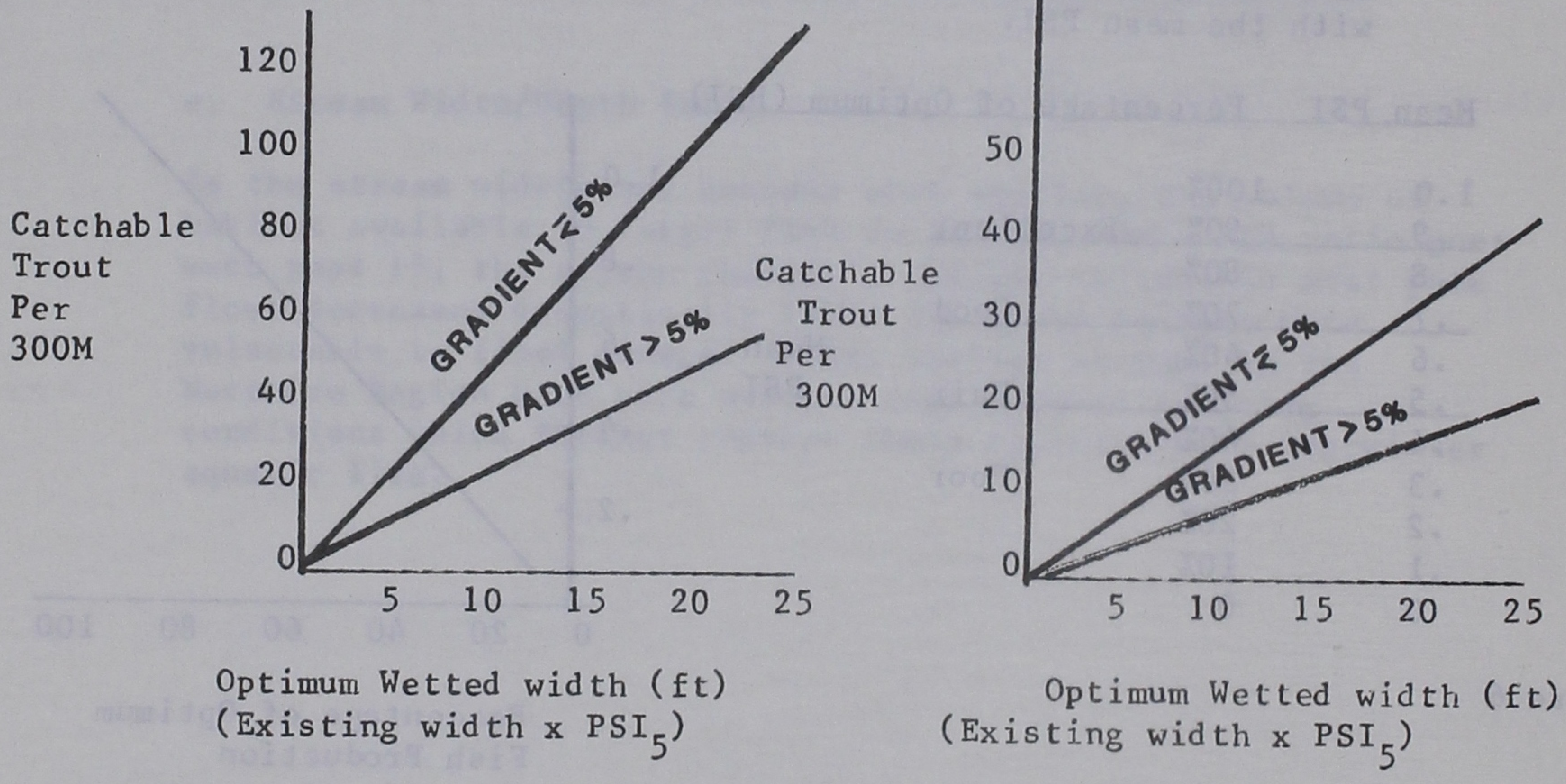


Figure 6

3. Maximum Fish Carrying Capacities

It is necessary to determine the fish carrying capacity that would occur under optimum stream conditions so that any tradeoffs in fish production that may be occurring under current riparian management can be identified. To do this, it is necessary to use the optimum stream width that would occur if bank damage was not occurring. Obviously, a 20 foot wide stream in excellent condition will support more fish than a stream that was originally 10 foot wide, but has widened to 20 feet because of alterations in the stream profile. To compensate for any width changes that may have occurred from grazing or scouring, multiply the existing stream width times the PSI_5 value obtained for the width/depth ratio (For those samples with a PSI for the W/D ratio of 0.5 or less, use the value of 0.5 to multiply times the existing stream width in determining optimum stream width). Two additional variables, the stream gradient and soil type for the drainage are needed to calculate the maximum trout population expected under the given conditions. Soil types charateristic of the drainages were divided into two major categories; grantics (or hard crystalline rocks) and non-granitics which consist largely of volcanic and sedimentary rocks. Water running over granitic soils is considered fairly sterile and less productive compared to drainages composed of volcanic or sedimentary material (Davis and Shovic - inpress). Also, stream gradient plays an important role in fish production. As the gradient increases, water velocities subsequently increase resulting in preferred spawning gravel moving downstream, less resting area available and increased difficulty to fish movement. For simplicity, five percent was used to divide steep and shallow gradient streams.

If actual carrying capacities for the stream being evaluated are known, they can be used in place of the productivity graphs. If this option is elected, the ouputs will have to be calculated by hand instead of using the spreadsheet.



-Non-Granitic Drainage-

-Granitic Drainage-

Figure 7

Now, the present carrying capacity can be compared to the potential carrying capacity by multiplying the percent of optimum times the expected carrying capacity expected to occur under optimum habitat.

conditions. The difference between the two would be the estimated loss in fish numbers that have occurred from present management.

The monetary value of the fishery is determined using Wildlife and Fish User Days (WFUDs). The average angler catches 0.5 fish per hour and a WFUD is 12 hours, therefore six fish would equal one WFUD. A WFUD has a $63.87 value (USDA 1985). The following equation determines the annual fishery value loss per allotment in dollars:

$$\frac{\text{Km of stream in allotment} \times \text{fish loss per year per km} \times \$63.87 \text{ per WFUD}}{\text{Six fish caught per WFUD}}$$

IV. User's Guide

A. General

The COWFISH program is designed to provide range specialists the ability to assess the affect current and past range management has on stream carrying capacity. Personnel with access to a Data General terminal will be able to use a computer program to evaluate the stream's current carrying capacity in terms of catchable per 300m, expected carrying capacity under optimum conditions, and the resultant tradeoff in carrying capacity given in terms of catchable trout numbers, WFUDs and dollars.

The user has the option of obtaining the results either manually by following the Guide to the Field Form or by recording the variables in the field and entering them into the computer program. The manual procedure provides the flexibility of obtaining the results while still out on the site.

B. Data Collection

Collect the sample data per the following instructions, and record it on the field form provided. A sample field form is shown as Figure 2.

Page 1 of the field form includes descriptive information about the stream, allotment, and sample site being evaluated. This information will be helpful in categorizing and interpreting the model outputs. Record your field sample date on Page 2. Record your narrative comments on Page 3. You have the option of doing your calculations on Page 4 or on your Data General terminal using the COW-FISH spreadsheet program.

1. Step 1 - Sample Point

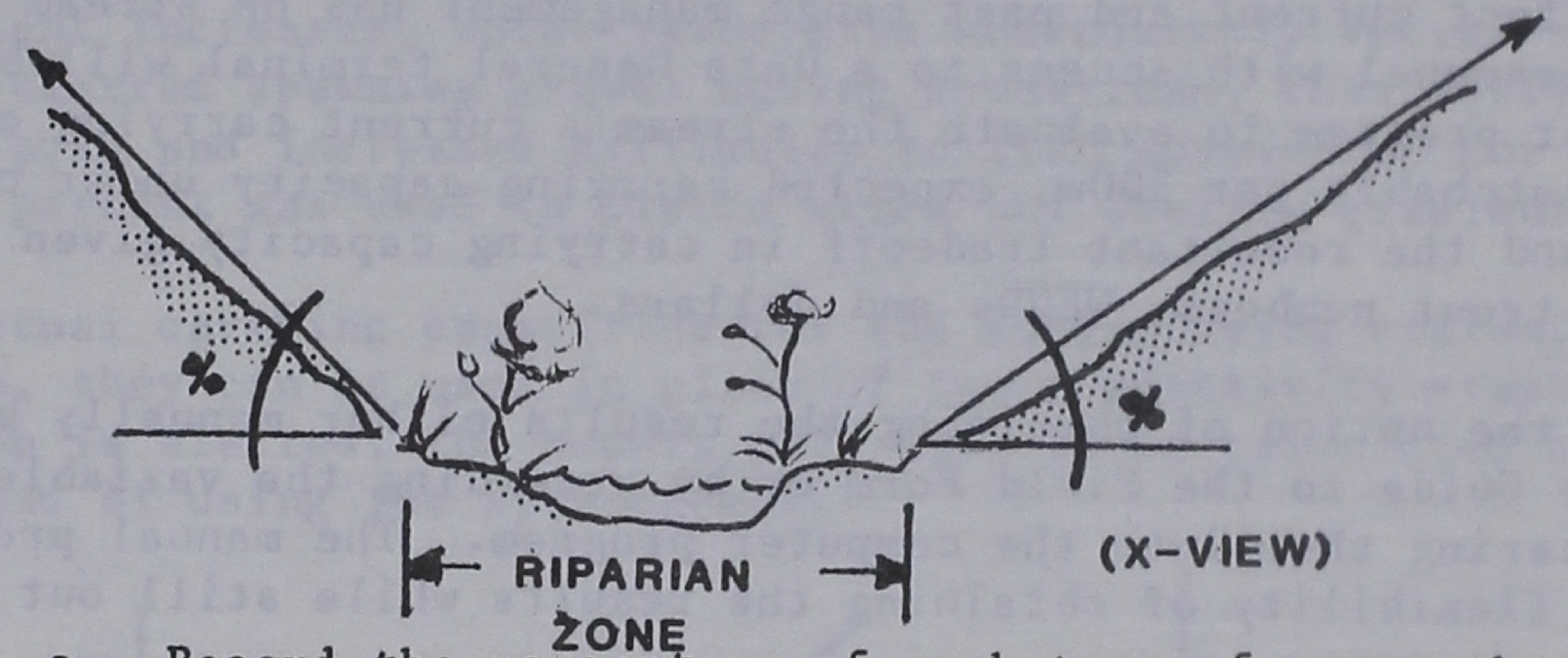
Select a sample point that is representative of the stream condition. If unsure, take several random sample points. Each sample includes a 100 foot section of stream. Data from five sites per stream mile would be needed to provide a 10 percent sample. The number of sample sites and/or length of stream section measures will be determined on the variability of the habitat and/or the variability of the damage occurring to the stream in question.

2. Step 2 - Sample Area Description

Complete the description of the sample area and record the information on Page 1 of the field form. The general description (Section B) information will require looking at maps and your allotment files. The site description (Section B) requires collecting the following field information.

a. Determine the vegetative type by percent for the site being analyzed. This pertains only to the vegetation within the riparian zone along the stream corridor.

b. The side valley slope gradient describes the change in gradient (in percentage) from the outside edge of the riparian zone to the immediate adjoining terrain on both sides of the stream.



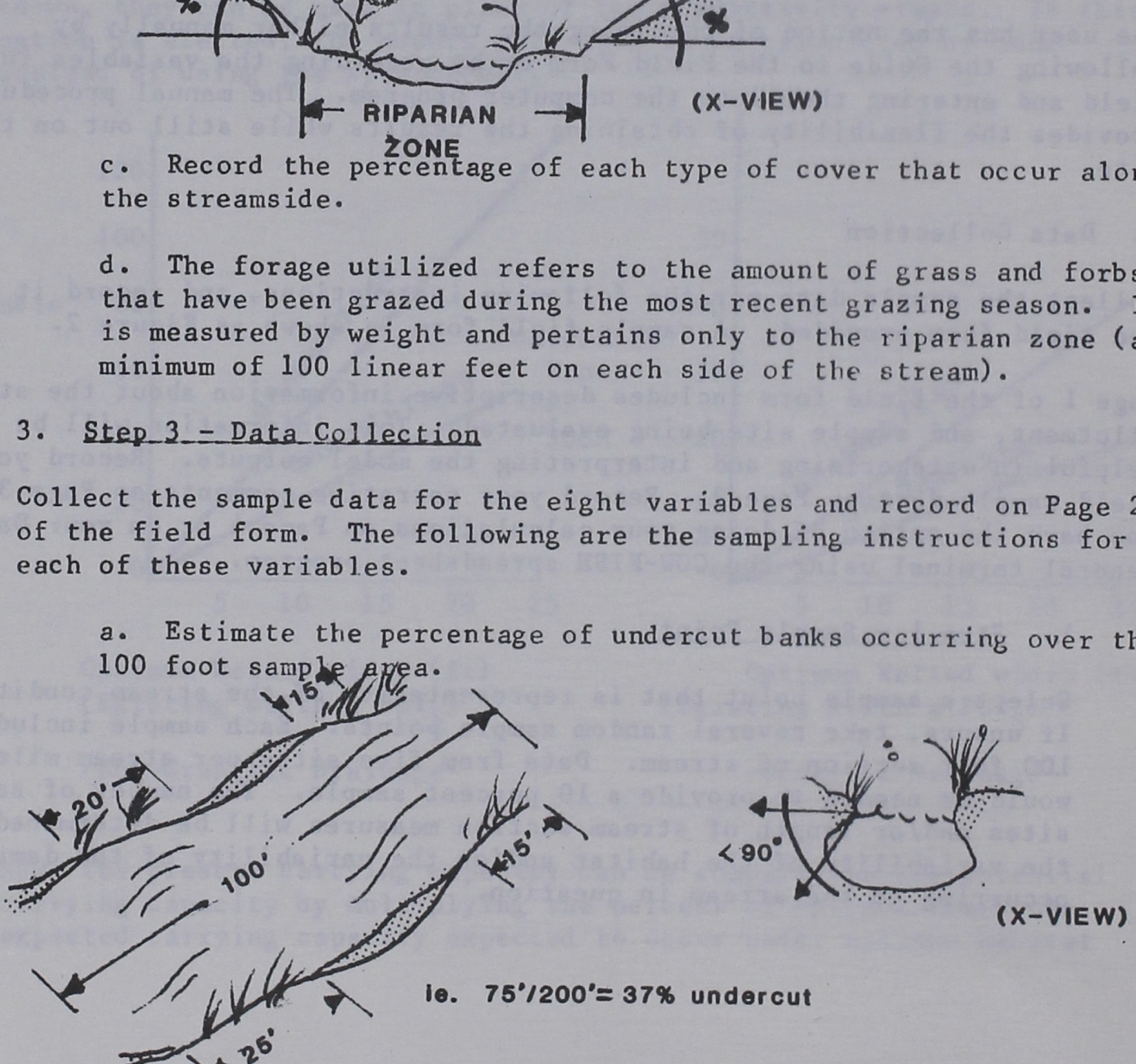
c. Record the percentage of each type of cover that occur along the streamside.

d. The forage utilized refers to the amount of grass and forbs that have been grazed during the most recent grazing season. It is measured by weight and pertains only to the riparian zone (a minimum of 100 linear feet on each side of the stream).

3. Step 3 - Data Collection

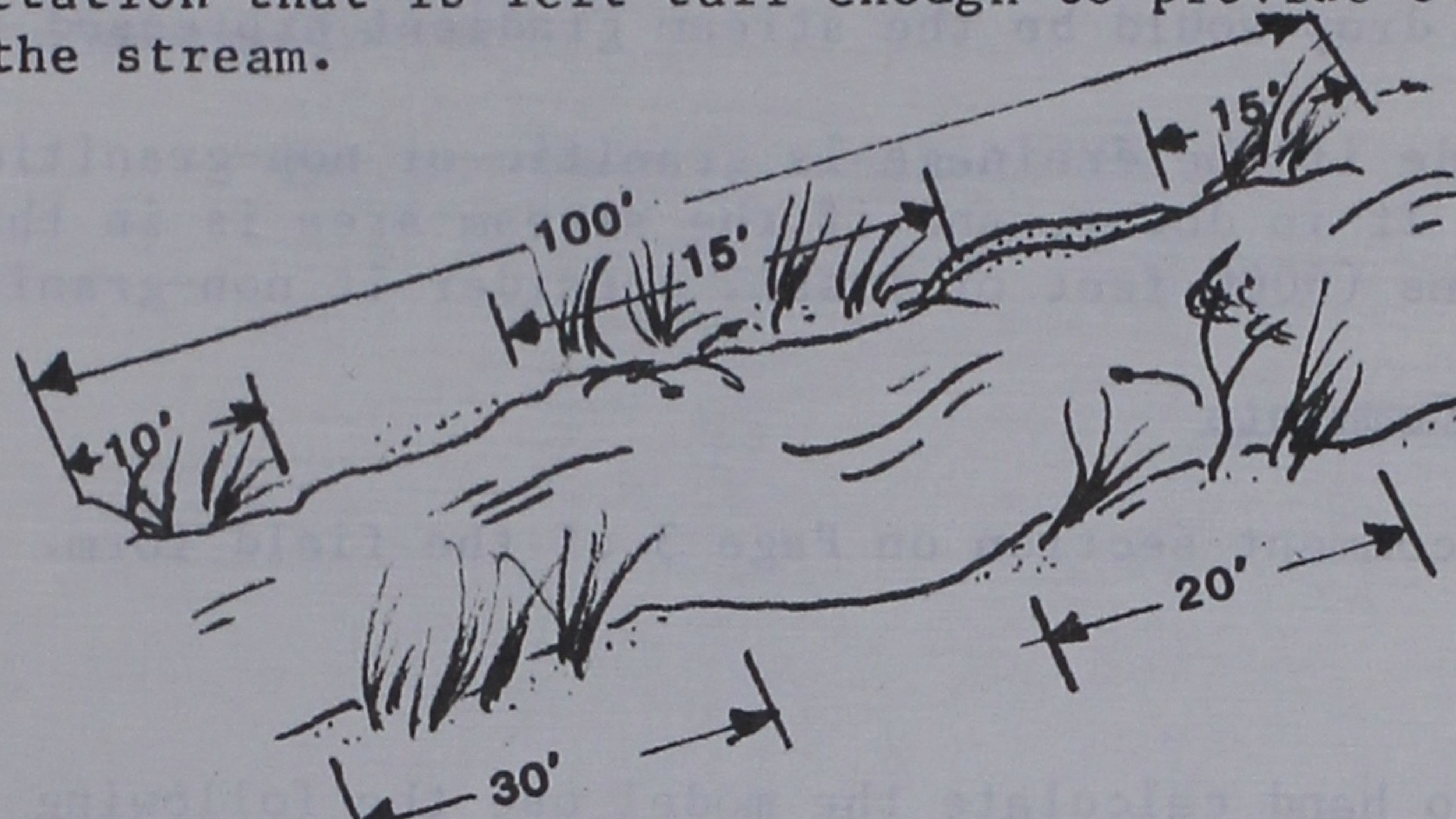
Collect the sample data for the eight variables and record on Page 2 of the field form. The following are the sampling instructions for each of these variables.

a. Estimate the percentage of undercut banks occurring over the 100 foot sample area.



ie. 75'/200'= 37% undercut

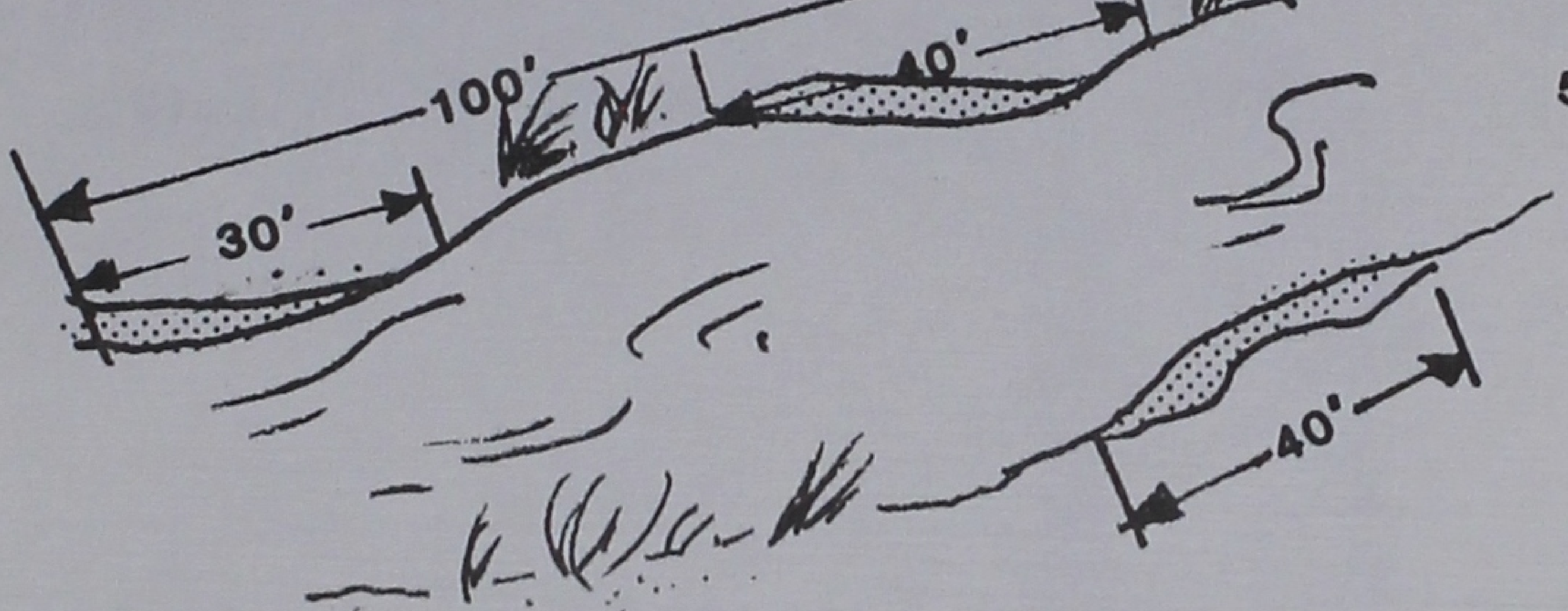
b. The percent of bank supporting vegetative overhang at the end of the grazing season is determined. This includes only vegetation that is left tall enough to provide overhanging cover to the stream.



ie. 90'/200'=

45% vegetative cover

c. The streambank soil alteration rating estimates the stability of both streambanks. Estimate the percentage of the streambank where soils are exposed or being trampled.



ie. 110'/200'=

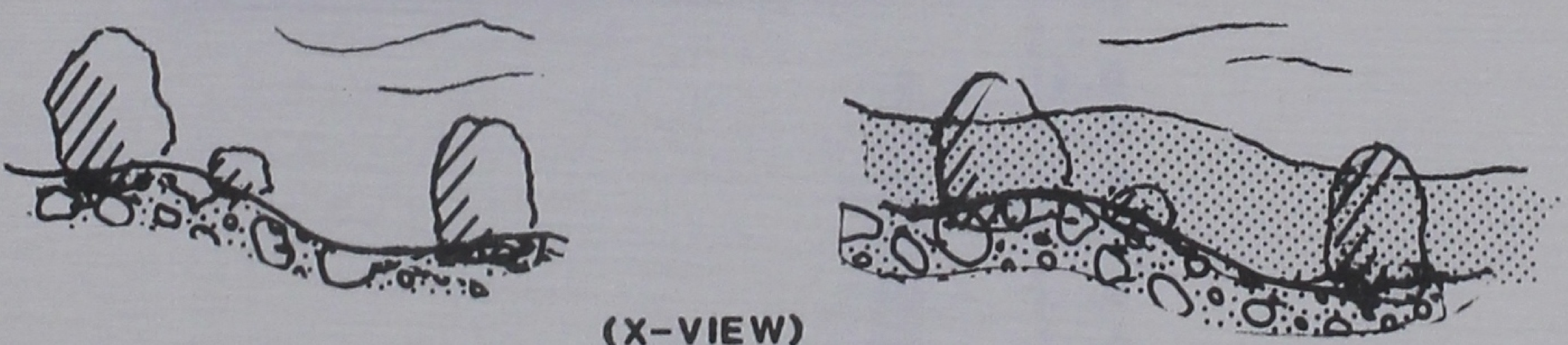
55% altered banks

d. Estimate the embeddedness (percent coverage of bottom substrate by fine material of 1/8 inch in diameter or less) over the riffle area. This is identified as those areas where stream bottom gravels are approximately 0.25 to 1.0 inches in diameter. Determine the PSI using Figure 4.

ie.

10% embeddedness

90% embeddedness



(X-VIEW)

e. The width/depth (W/D) ratio describes how wide the stream is compared to its depth. Stream depths can be determined by using a stick or branch and estimating the water depth at 1/4, 1/2, and 3/4 distance across the stream. Total these three depths, divide by 4 and round off to the nearest 1/2 foot. The mean stream width is also an estimate.

f. The stream gradient can be determined by estimating the vertical change in elevation for 100 feet of stream. This vertical drop would be the stream gradient expressed in percent.

g. Decide if the drainage is granitic or non-granitic in origin. If in doubt, and if the stream area is in the lower elevations (6000 feet or less), consider it non-granitic.

4. Step 4 - Comments

Complete the comment section on Page 3 of the field form.

C. Calculations

If you are going to hand calculate the model use the following instructions Step 5A to complete page 5 of the field form. If you want to use the Cowfish spreadsheet program to automatically do your calculation turn to Step 5B on how to use the program. In either case you are done with field data collection for this sample point.

WORKSHEET CALCULATIONS

Step 5A - PSI Calculations

Determine the PSI values for the five variables using the following tables. Put the PSI in the appropriate space on the calculation sheet (1-5).

1. PSI - % Streambank Undercut

Percent Undercut Bank	PSI
85	1.0
75	.9
60	.8
50	.7
45	.6
40	.5
35	.4
30	.3
25	.2
10	.1
0	0

2. PSI$_2$ - % Vegetation Overhang

Percent Vegetation Overhang	PSI$_2$
100	1.0
75	.9
55	.8
45	.7
40	.6
35	.5
25	.4
20	.3
10	.2
0	.1
0	0

3. PSI$_3$ - % Streambank Altered

Percent Streambank Altered	PSI$_3$
0	1.0
15	.9
30	.8
35	.7
40	.6
45	.5
50	.4
65	.3
80	.2
90	.2
100	.2

4. PSI_4 - % Embeddedness

Percent Embeddedness	PSI_4
0	1.0
10	.9
20	.8
25	.7
30	.6
35	.5
40	.4
43	.3
46	.2
50	.1
55	0

5. PSI_5 Calculate stream width/depth ratio in space provided. Then determine PSI_5 from below.

W/D Ratio	PSI_5
<5	1.0
6-12	.9
13-18	.8
19	.7
20	.6
21	.5
23	.4
25	.3
26	.2
>26	.1

Step 6A - HSI Calculation

Calculate the average PSI in the space provided on line 6. Then determine the Percent of Optimum Fish Production (HSI) and record it on line 7.

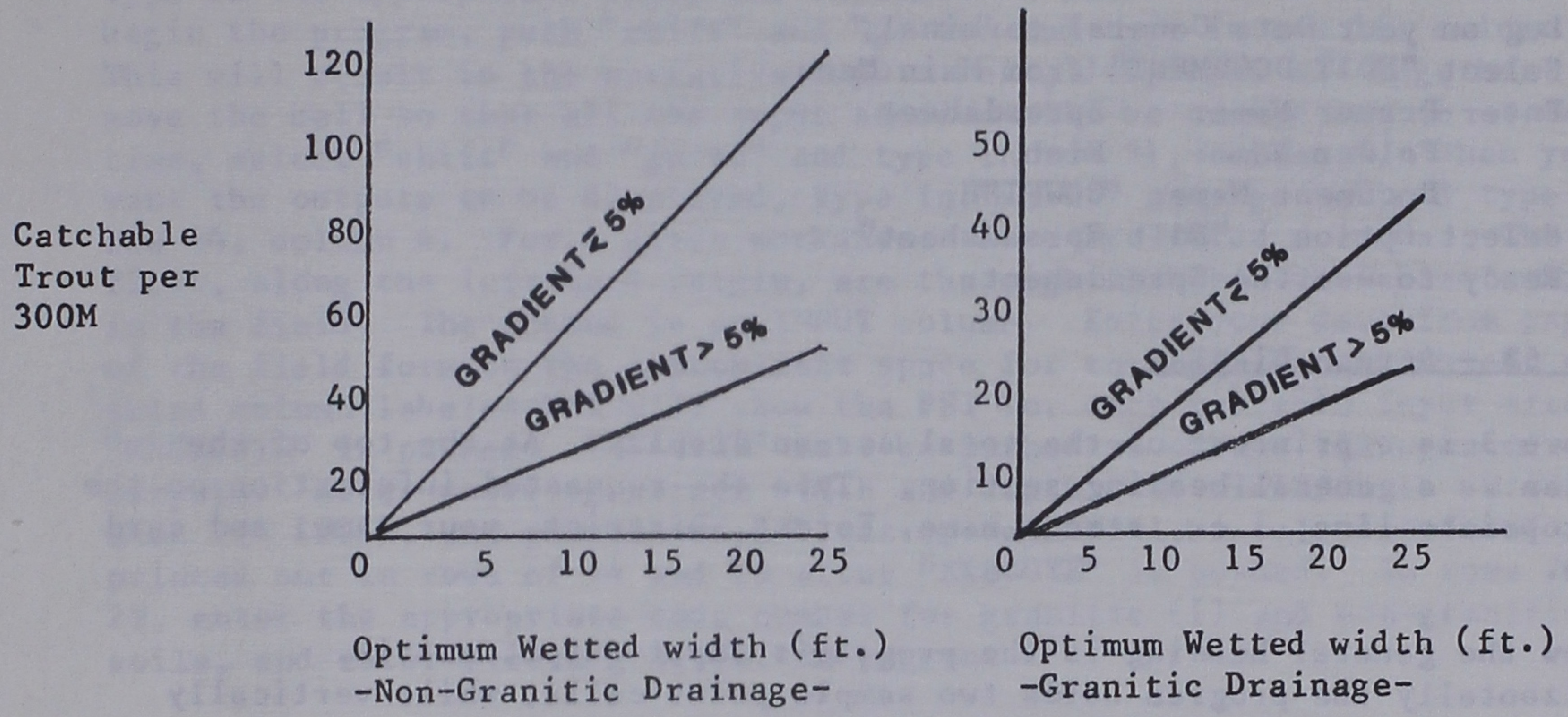
Mean PSI	Percentage of Optimum (HSI)	
1.0	100%	= EXCELLENT
.9	90%	
.8	80%	= GOOD
.7	70%	
.6	60%	= FAIR
.5	50%	
.4	40%	= POOR
.3	30%	
.2	20%	
.1	10%	
0	0	

Step 7A - Optimum Stream Width

Calculate the optimum stream width in the space provided on line 8 utilizing the information from line 5. Record stream gradient and type of soils characteristic the drainage in question on lines 9 and 10.

Step 8A - Calculate Optimum Fish Production

Determine Optimum Fish Production using the following graphics. Use the optimum stream width, stream gradient, and granitic soils information from Step 7A (lines 8, 9, and 10). Record on line 11.



Step 9A - Calculate Existing Fish Production

Calculate existing fish production by multiplying Percent of Habitat Optimum (line 7) times Optimum Fish Production (line 11). Record on line 12.

Step 10A - Calculate Loss

Calculate the numbers of fish, recreation use, and economic loss associated with the difference between existing and optimum carrying capacity. On line 13 record the Fish Loss from the calculation of Optimum Fish Production (line 11) minus Existing Fish Production (line 12). On line 14, record the Recreation Loss (WFUDS) by dividing the Fish Loss (line 13) by 6 (the number of fish per WFUD). On line 15, record the Economic Loss by multiplying the Recreation Loss (line 14) by $63.87 (the dollar value of a WFUD).

D. Using the COWFISH Spreadsheet Program

The new CEO based spreadsheet uses the same function, edit, and cursor movement commands as the CEO word processor. Consult the CEO Decision Base Spreadsheet User's Manual for more specific program operation.

Step 5B - Getting the Program Started

You can access the COWFISH spreadsheet from the CEO Main Menu like any other document. Spreadsheets are "SPD" type of documents. Complete the following steps to access COWFISH:

1. Log on your Data General terminal,
2. Select "EDIT DOCUMENT" from Main Menu,
3. Enter Drawer Name: Spreadsheet
   Folder Name: Fish
   Document Name: COWFISH,
4. Select Option 1 "Edit Spreadsheet",
5. Ready to use the Spreadsheet.

Step 6B - Screen Display

Figure 3 is a printout of the total screen display. At the top of the screen is a general heading section. Type the requested information on the appropriate line; i.e., stream name, Forest, District, your name, and card date.

Below the general heading is the program's input-output matrix. Horizontally the program holds two sample point cells, while vertically three cells exist giving a total working storage of six sample cells. This gives the user the capability to scroll through six worksheets and store up to six sample points under one file name. The entire width of one worksheet is visible, but only a portion is visible vertically at a time. You must use the cursor movement keys to move up and down the worksheet, or to move to another cell.

LEFT COLUMN- Shifts the current location one column to the left.

RIGHT COLUMN- Shifts the current location one column to the right.

UP ROW- Shifts the current location up one row.

DOWN ROW- Shifts the current location down one row.

LEFT SCREEN- Moves the previous group of columns of the spreadsheet into the spreadsheet window. The current location maintains its row position and moves to the leftmost column in the spreadsheet window.

RIGHT SCREEN- Moves the next group of columns of the spreadsheet into the spreadsheet window. The current location maintains its row position and moves to the rightmost column in the spreadsheet window.

The PREVIOUS SCREEN function key moves the previous group of rows of the spreadsheet window. The current location maintains its column position and moves to the top row in the spreadsheet window.

The NEXT SCREEN function key moves the next group of rows of the spreadsheet into the spreadsheet window. The current location maintains its column position and moves to the top row in the spreadsheet window.

Step 7B - Data Input

Now you are ready to input data and interact with the program. You simply type in the appropriate space the information asked for on the screen. To begin the program, push "shift" and "go to" and type in row 18, column 4. This will result in the narrative inputs being displayed all together. To move the cell so that all the input section will be on the screen at one time, select "shift" and "go to" and type in row 31, column 4. When you want the outputs to be displayed, type in "shift" and "go to" and type in row 44, column 4. For a given worksheet there are three columns. The first, along the left hand margin, are the eight habitat variables sampled in the field. The second is an INPUT column. Enter your data from page 2 of the field form in the appropriate space for each of the variables. The third column labeled PSI will show the PSI for each variable input after "EXCECUTE" is pushed. "EXECUTE" must be pushed to obtain the updated outputs. After entering stream width and depth, the width/depth ratio, mean PSI (HSI), and percent of habitat optimum will be calculated and printed out in rows of 24 and 25 after "EXECUTE" is pushed. In rows 28 and 29, enter the appropriate code number for granitic (1) and non-granitic (0) soils, and enter stream gradient in percent.

Step 8B - Analysis Outputs

The results of the analysis will automatically be calculated and printed out below the horizontal line in row 31. The outputs calculated are the numbers of catchable trout per 300 meters of stream for (1) optional conditions for this stream and (2) existing conditions. The losses from optional conditions are also displayed; i.e., number of trout per 300 meters of stream per year, recreation loss in WFUDS, and economic loss in dollars per 300 meters of stream per year.

Step 9B - Moving to Another Worksheet

If you want to run another worksheet for this sample stream, or another run at this sample point and be able to simultaneously compare your results, move to another worksheet in the spreadsheet space. You can move horizontally between worksheets with the Left Screen and Right Screen cursor keys. You can move vertically between worksheets with the Previous Screen and Next Screen keys. This spreadsheet has six worksheets built into it:

```
          _____________________________Columns_____________________________
          1                           6: 7                               13
          :                             :                                 :
          :        Worksheet            :           Worksheet             :
          :            1                :               2                 :
          :                             :                                 :
          50                            :                                 :
       ------------------------------------------------------------------------
     rows 51
          :                             :
          :         Worksheet           :           Worksheet             :
          :             3               :               4                 :
          :                             :                                 :
          :                             :                                 :
          100                           :                                 :
       ------------------------------------------------------------------------
          101
          :
          :         Worksheet           :           Worksheet             :
          :             5               :               6                 :
          :                             :                                 :
          :                             :                                 :
          :                             :                                 :
          150
```

Step 10B - Printing, Filing, and Getting Out

Once you have completed your analysis, you have the option of saving your spreadsheet and filing it as a spreadsheet document or word processing document, and/or getting a paper printout of your analysis. Saving your analysis as a word processing document gives you the capability to incorporate it directly into a report or use the word processor to edit your document. Saving your analysis as a spreadsheet document retains your capability to use it for future analysis purposes.

To file your document:

1. Press the SAVE function key.
2. Select the ALL when asked how much to save.
3. Select the SPREADSHEET or WORD PROCESSING DOCUMENT when asked type of document.
4. If saving as a Word Proccessing Document, select VALUES when asked which format to save.
5. Enter Drawer Name, Folder Name, and Document Name you want to assign to the saved spreadsheet.

To print your document:

1. You can print your spreadsheet from the Print Document option in the CEO Main Menu like any other document.

2. You can print a single copy of your spreadsheet when you exit the spreadsheet processor. To execute, press CMD and PRINT keys at the same time.

Once you are ready to exit the program:

Press CANCEL/EXIT key.

IV Figure 2

Field Form 1/

A. Description

1. General

Map Unit ____________

Allotment ____________ Number __________ Forest __________ District ________

Range Type(s) ________________ Pasture__________ No.______ Elevation________

Livestock Class ____

Range Type ____________Range Suitability __________Slope Class __________

Season of Use ______________________________ Grazing System ______________

Location 1/4 Section ______________ Township ______________ Range__________

Stream ____ Date ________________

Observer(s) ____

Site

1. Riparian Habitat Type (percent

____________________ grass/forbs
____________________ sedges
____________________ grass/willow (< or = 50% willow)
____________________ grass/willow (>50% willow)
____________________ willow/conifer
____________________ other (specify)

2. Side valley slope gradient of riparian zone

Left Bank ________________% Right Bank ________________&

3. Dominant Streamside cover (percent)

	Left Bank	Right Bank (Looking Downstream)
a. palatable shrubs	________	________
b. Unpalatable shrubs	________	________
c. tree form	________	________
d. grass forb	________	________
e. >50% soil, rock	________	________

4. Percentage forage utilization in riparian zone. ________%

1/ Instructions for completing this form are in the COWFISH user's guide.

B. Sample Data

1. Percent Streambank Undercut. (PSI_1) _______%

2. Percent vegetative cover overhang (grass/forbs) remaining by volume. (PSI_2) _______%

3. Streambank soil alternation rating. Show the percentage of each bank that is actually eroding or showing mechanical damage, vegetative cover removal or other forms of stress. (PSI_3) _______%

4. Percent of bottom substrate covered with fine sediment (less than 1/8 inches in diameter). (PSI_4) _______%

5. Average Stream width. (PSI_5) ________feet

6. Average Stream depth. (PSI_5) ________feet

7. Average stream gradient. _______%

8. Granitic soils present. ☐ yes ☐ no

9. Length of stream reach represented by sample. ------M

C. Comments

Observer's evaluation of riparian habitat trend and cause of any degrading or improving riparian habitat conditions:

Observer's comments on solutions to any degradation problem:

Remarks (diversions, crossings, trailing areas, etc.):

V. Calculation Worksheet (Optional)

Data PSI

1. PSI_1 (Streambank undercut ________% = ________
2. PSI_2 (vegetative cover overhang) ________% = ________
3. PSI_3 (streambank soil alteration) ________% = ________
4. PSI_4 (stream embeddedness) ________% = ________
5. PSI_5 (stream width/depth) width ____/depth____ = ____/____

Total ________

6. Calculate average PSI (total ÷5) Average PSI ________
7. Percent of Habitat Optimum (HSI) ________%
8. Optimum stream width = stream width ______ x PSI_5______ = ________
9. Stream Gradient ________
10. Granitic Soils ________
11. Optimum Fish Production (based on 8, 9, & 10) ________ per 300M
12. Existing Fish Production = (11) x (7) ________ per 300M
13. Fish Loss = (11) - (12) ________ per 300M
14. Recreation Loss = (12) ÷6 = ______ WFUD per 300M per year
15. Economic Loss = (14) x $63.87 = ______________ per 300M per year

Example of Printout

```
                                  COW FISH MODEL - REGION 1
                                            5/86
STREAM NAME:         ______________________________________________

FOREST:    _____________   DISTRICT:  ________________________

ASSESSED BY:         _____________   DATE:   ___________________

SAMPLE #:  __________LENGTH OF REACH REPRESENTED BY SAMPLE:   __________

                              INPUT                         PSI

% STREAMBANK UNDERCUT?        40.00                         0.50

% VEG. COVER OVERHANG?        75.00                         0.90

% STREAMBANK ALTERATION?      40.00                         0.60

% STREAM EMBEDDEDNESS?        10.00                         0.90

STREAM WIDTH?                 26.00

STREAM DEPTH?                  2.00    RATIO      13.00     0.80

MEAN PSI:               0.74                 % OF OPT=       70 %

GRANITIC SOILS (GRAN=1,NON=0)?    0
    GRADIENT?                  1.00 %
___________________________________________________________________

OPTIMUM CATCHABLE TROUT/300M:   104

EXISTING FISH PRODUCTION/300M:   73

FISH LOSS PER 300M/YR:           31

LOSS OF WL/FISH USER DAYS
     PER 300M/YR:                 5

ECONOMIC LOSS PER 300M/YR:  $332.12
```

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